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logic

One of the more complex disciplines associated with the field of philosophy is logic. The term comes from the Greek word logos, which has such a variety of meanings that it becomes difficult to give a precise definition of logic. Among the meanings of logos are 'reason,' 'rule,' 'discourse,' 'sentence,' 'word,' 'ratio,' 'account,' 'rational principle,' and 'definition.' Because of the number of possible interpretations, the subject matter of logic has variously been defined as 'the laws of thought,' 'the rules of right reasoning,' 'the principles of valid argumentation,' and 'the study of truths (true statements) based solely on the terms they contain.'

The last definition, and probably the least known one, implies the curious notion that the 'facts' of logic need not necessarily coincide with the everyday realities of life. If a statement, or proposition, is analyzed solely within itself, the statement may be logically true even when contradicted by sense, experience, or knowledge. Or it may be logically true, even if the facts it presents are doubtful or uncertain. This is true because logic depends, first of all, on the ability to move from a premise to a conclusion based on the premise. As an example, the philosopher Aristotle used the following proposition as a simple, logical truth: 'If sight is perception, the objects of sight are objects of perception.' One can grasp the truth of the statement, regardless what opinions he holds about the relationship of sight and perception. This is a very simple 'if-then' proposition. If, within its own terms only, the 'if' statement is true, it follows that the 'then' statement is true. The proposition is not intended to lead one to inquire into the nature of sight or perception but to demonstrate the process of correct reasoning. Thus even a seemingly ridiculous statement such as 'If all animals are purple, then cows are purple,' is correct in its reasoning.

Such a use of so-called true statements, without regard for the everyday realities, may seem frivolous and insignificant. In fact, such logic, which moves from premise to premise in a strict and logical sequence, is quite useful in the areas of computer science and mathematics. A computer will execute a program if the statements are in a prescribed order and correctly stated with regard to the capabilities of the computer. The statements themselves may be totally untrue in terms of factual knowledge, or they may be completely true. Among other things, this allows people who use computers to have them answer 'what-if' sorts of problems. In mathematics virtually all argumentation is carried out in logical terms. The truth of a mathematical proposition has no necessary relation to the wider world of truth or knowledge. What matters is moving correctly from one premise to the next in precise, sequential order. Only in this way can the abstract statements of mathematics be demonstrated as true. The techniques used in mathematical logic have been adapted by other sciences, particularly physics, chemistry, and astronomy.

Kinds of Logic

The discipline of logic came into use many centuries ago as a branch of philosophy. It has since diversified to the extent that there are now several separate disciplines of logic.

Principles of logic have found uses in the natural sciences, physical sciences, statistics, language studies, psychology, law, and education to name a few. In the social sciences, the logic used is borrowed from such

fields as probability theory, game theory, utility theory, and operations research, all of which are highly complex areas of study.

The origins of logic, in both East and West, were first associated with an interest in the grammar of language and in the methods of argumentation and discussion in any field of interest, be it law, religion, philosophy, or science. Aristotle, in the 4th century BC, delineated two different types of logic-**deductive** reasoning and inductive reasoning-each with specific applications.

Deductive reasoning.

When a person uses either a general principle or a collection of specific data to draw a specific conclusion, he is using **deductive** reasoning. A **deductive** argument is frequently stated in the form of a syllogism. A syllogism consists of three parts: the major premise, the minor premise, and the conclusion. The following example shows the order of the parts:

All men are mortal;

Socrates is a man;

Therefore Socrates is mortal.

Broken down in this way, an argument is far easier to test for fallacies, or errors, than when stated in ordinary conversational form. The conclusion must be valid if the premises are true-true in their own terms, not necessarily in relation to the truth of the world at large.

Inductive reasoning.

When a person uses a number of established facts to draw a general conclusion, he uses inductive reasoning. This is the kind of logic normally used in the sciences. For example, a scientist may gather all the facts he can about a certain disease from observation and experiment. Then he draws his inductive conclusion, perhaps that a certain microbe causes the disease. An inductive argument, however, is never final: It is always open to the possibility of being falsified. For instance, the observation of swans over the centuries has led to the conclusion that all swans are white. The discovery of one black swan would falsify this theory, but it would still be true that most swans are white. Inductive reasoning is always subject to revision if new facts are discovered. It is by this process of induction and falsification that progress is made in the sciences.